CRUSTAL GROWTH AND REWORKING ALONG THE ANTARCTIC PENINSULA: AN ISOTOPIC APPROACH

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RESUMEN

Se Compara las características de isotopes de Nd y las edades modeladas ("model ages") de rocas igneas relacionadas a subducción de la Peninsula Antarctico, a datos publicados de la Cordillera Andina. Se relaciona variaciónes en las edades modeladas, en tiempo y tambien en espacio, a la evolución tectonica de partes diferentes del margin pacifico de Gondwana, anteriormente conjuntadas.

Antarctic Peninsula, subduction-related magmatism, neodymium isotopes, model ages.

Introduction

Continental destructive plate margins are the most important sites of continental crustal growth in the geological record. During subduction-related magmatism, a variety of different geochemical reservoirs may be tapped, and it is generally accepted that subduction-related magmas may contain contributions from depleted mantle, continental crust, variably enriched continental lithospheric mantle, subducted terriginous and pelagic sediments, and the products of slab de-watering. Variable amounts of interaction between the above geochemical reservoirs leads to the geochemical diversity of magmas erupted at active continental margins. However, because some of the above components have similar trace element and isotopic characteristics (e.g. terriginous sediment derived from subduction-related granitoids) determining the contributions from each component may be problematical.

Neodymium isotope systematics, and in particular neodymium 'model ages' have been utilised by a number of workers to give a broad overview of the relative contributions from depleted mantle and crust to magmas during arc evolution, and to separate paeriods of intracrustal re-working from the growth of new crust from the mantle (e.g. DePaolo, 1981; Miller & Harris, 1989).

In this study, we investigate temporal and spatial variations in the Nd-isotope characteristics of arc-related rocks from the Antarctic Peninsula, which was the site of almost 200 Ma of continuous subduction-related magmatism and formed part of the Pacific margin of Gondwana. Previously published geochronological and elemental data along with new isotopic data allow the identification of intrusive rocks which were generated from depleted mantle sources as well as material which clearly represents anatectic melts of pre-existing crustal rocks. The relative contributions of depleted mantle and lithosphere to magmatism can therefore be assessed. We present 83 previously unpublished Nd-isotope analyses supplemented by 50 published analyses of a variety of arc rocks, including pre-subduction gneissose basement, metasedimentary and sedimentary rocks from the accretionary prism complex and back-arc basin and post-subduction alkali basalts. From this data, and by comparison with published analyses for the central Andes, we demonstrate that similar processes of magmagenesis involving similar source compositions (depleted mantle and continental crust), occurred in different parts of the supposedly contiguous Pacific margin of Gondwana but at different times.

Geochronology.

The majority of the exposed geology of the Antarctic Peninsula can be accounted for by processes related to

involvement of significantly older continental lithosphere during the genesis of an individual sample, whereas a high MATE value gives a minimum model age of the re-worked continental crust.

What is apparent from this study is that the influence of a crustal source-region increased throughout the late Palaeozoic upto a maximum in the Middle Jurassic. It is also clear that the greatest influence from depleted mantle i.e. samples with the youngest model ages (MATE=0.3-0.7 G.y.), occurred during the mid-Palaeozoic and Tertiary, culminating in the eruption of the Late Cenozoic (7-0.1 Ma) post-subduction alkali basalts. Therefore, the most important periods of formation of new crust from depleted mantle were during the late Paleaozoic and Tertiary, whereas during the Late Triassic and Middle Jurassic magmas underwent significant interaction with pre-exisitng crustal sources. These differences appear to be controlled by large-scale tectonic processes. A period of steep slab dips and associated intra-arc extension during the late Creataceous resulted in the generation of granitoids from dominantle deplteds sources, whereas shallower slab-dips in Triassic-Jurassic times resulted in a broad shallow zone of partial melting in the mantle wedge which may may have provided far greater potential for crust-mantle interactions.

Miller & Harris (1989) showed that during the late Palaeozoic, orogenesis in the Central Andes was predominantly by intracrustal re-working. During the Jurassic, a change in tectonic style resulted in the onset of crustal growth before a return to predominantly intracrustal processes in the last 30 Ma. This is illustrated in Fig. 2. Some notable features of this diagram are that both the maximum crustal residence

Fig.1

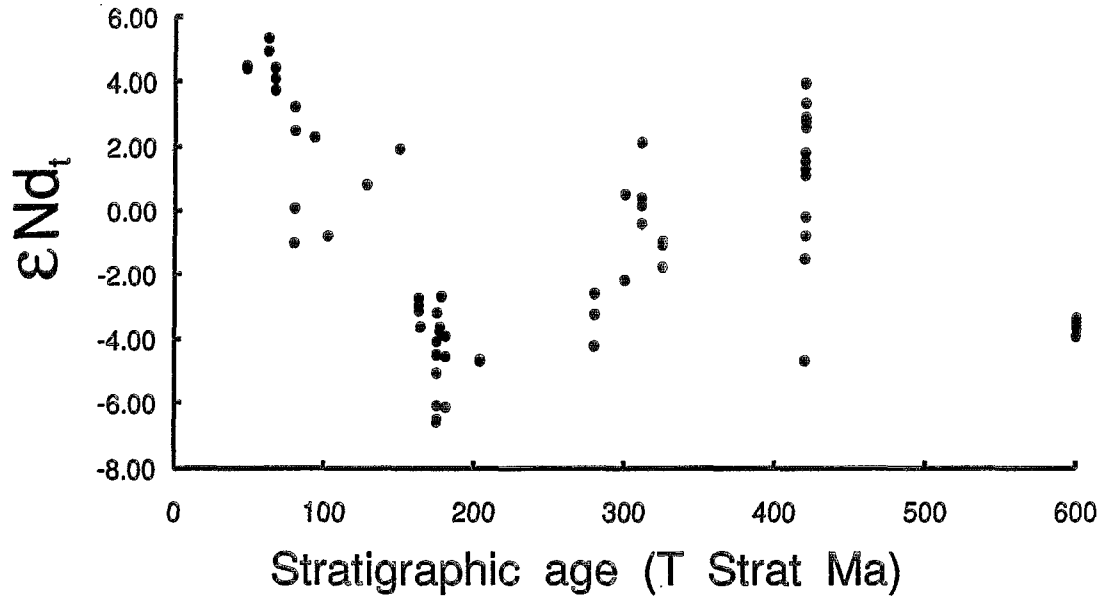
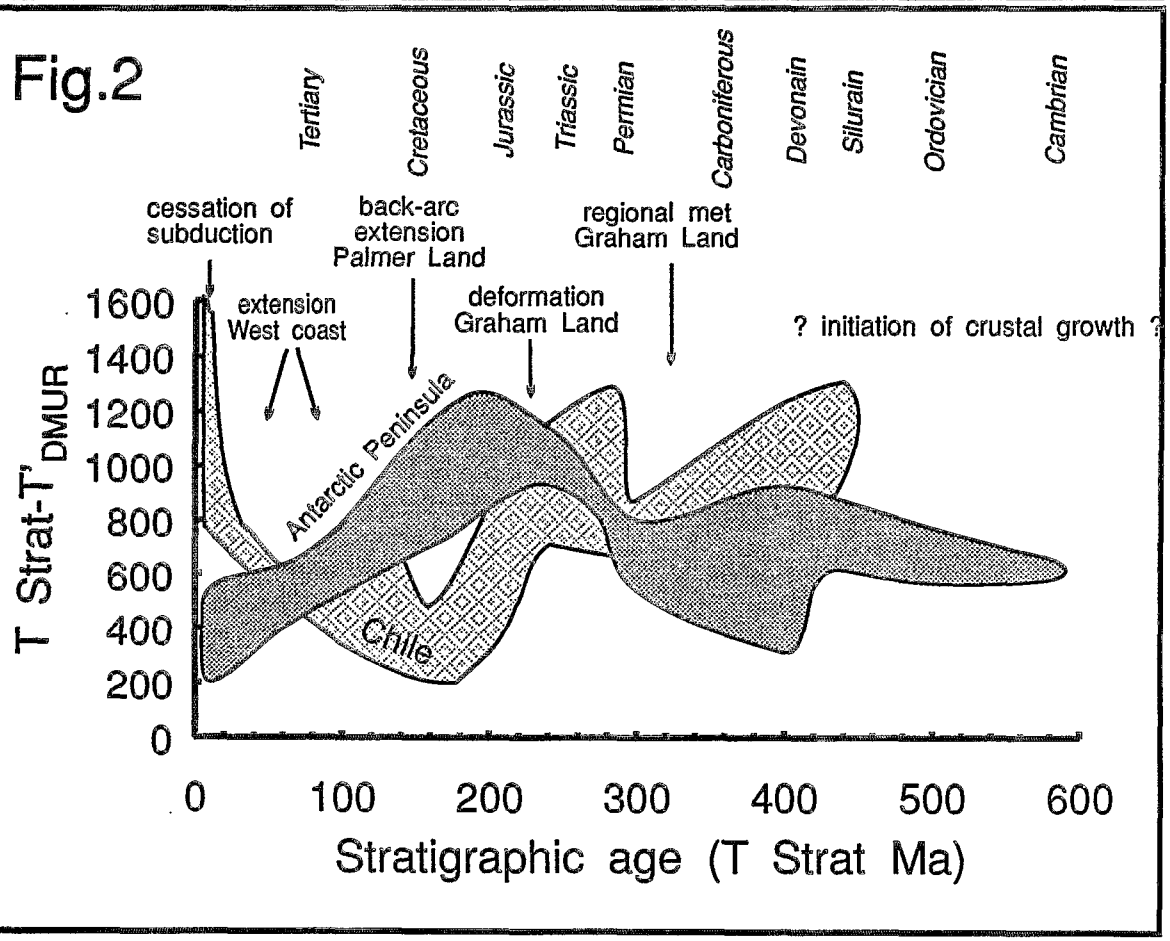

6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
εNd$_t$
0
100
200
300
400
500
600
Stratigraphic age (T Strat Ma)

Fig.2


Tertiary
Cretaceous
Jurassic
Triassic
Permian
Carboniferous
Devonain
Silurain
Ordovician
Cambrian
cessation of subduction
back-arc extension Palmer Land
regional met Graham Land
extension West coast
deformation Graham Land
? initiation of crustal growth ?
Antarctic Peninsula
Chile
1600
1400
1200
1000
800
600
400
200
0
T Strat-T'DMUR
0
100
200
300
400
500
600
Stratigraphic age (T Strat Ma)